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TRAFFIC SPEED REPORT NO. 82
TRUCK WEIGHT-SPEED STUDY

DECEMBER 1965
NO. 31

Joint
Highway
Research
Project

PURDUE UNIVERSITY
LAFAYETTE INDIANA

by
D. A. WRIGHT

Progress Report

Traffic Speed Report No. 82

December 9, 1965

TO: G. A. Leonards, Director
Joint Highway Research Project

File: 8-3-4

Project: C-36-10D

FROM: H. L. Michael, Associate Director
Joint Highway Research Project

Attached is a Progress Report entitled "Traffic Speed Report No. 82", conducted in August and September of 1965. The report was prepared by Mr. Darrell A. Wright, Graduate Assistant on our staff, under the direction of Professor H. L. Michael.

This report contains the results of the 1965 study of the relationship between truck weights and truck speeds. The report was prepared from data obtained during the annual truck weight study performed by the Highway Planning Survey Section of the Indiana State Highway Commission. The Joint Highway Research Project has cooperated in this study in a similar manner for many years.

The report is presented to the Board for information and the record. It is requested that approval be granted to distribute copies of the report to the Indiana State Highway Commission, the Bureau of Public Roads, the State Police, the Office of Traffic Safety, and the Traffic Safety Foundation.

Respectfully submitted,

*Harold L. Michael*_{BC}
Harold L. Michael, Secretary

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Progress Report

TRAFFIC SPEED REPORT NO. 82

TRUCK WEIGHT - SPEED STUDY

by

Darrell A. Wright
Graduate Assistant

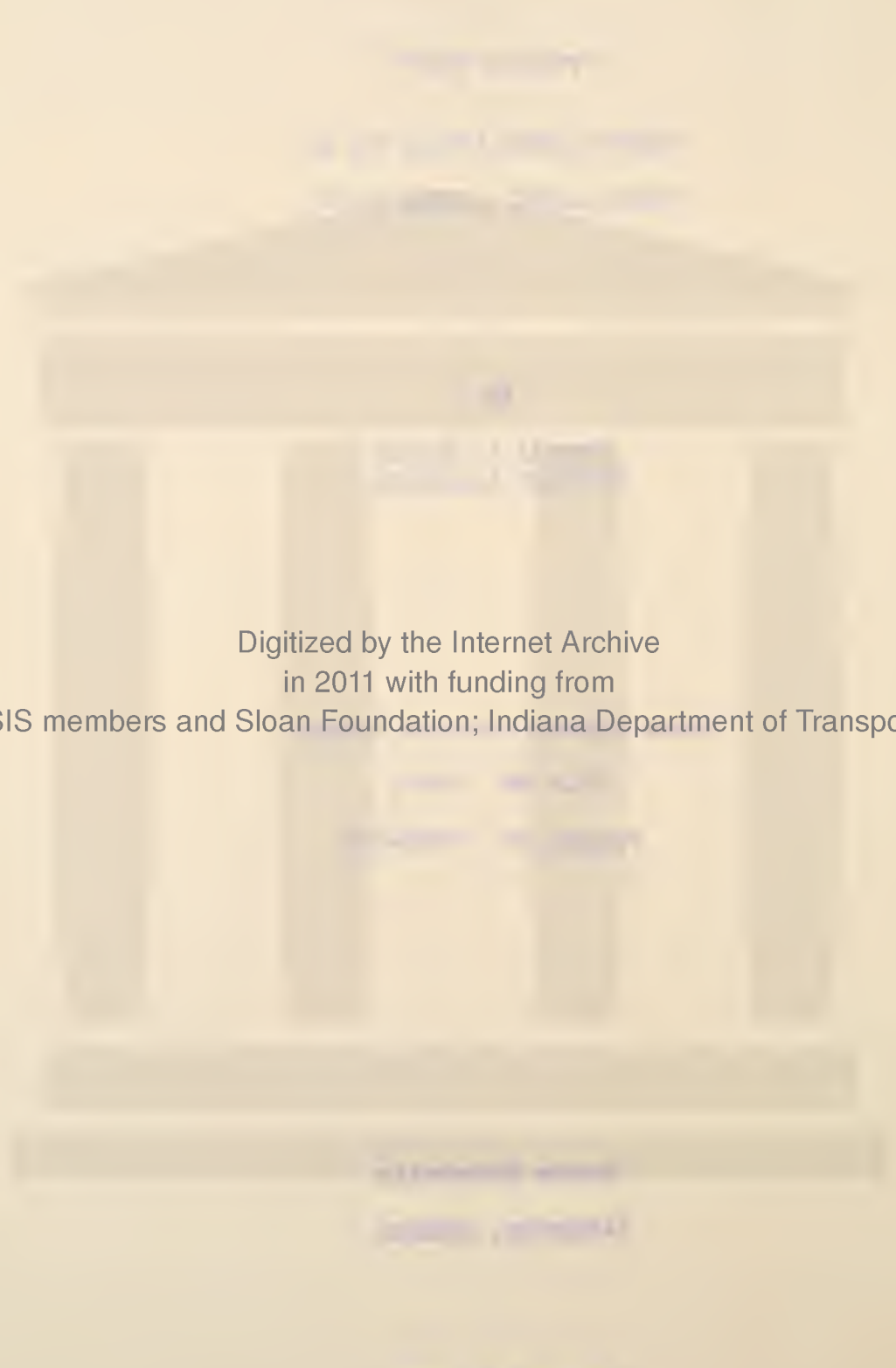
Joint Highway Research Project

File No: 8-3-4

Project No: C-36-10D

Purdue University
Lafayette, Indiana

December 9, 1965



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ABSTRACT

This report is the annual, continuing study of the relationship between truck weight and truck speed. The weight and speed of trucks on two-lane and four-lane highways in Indiana were taken during August and September, 1965.

Analysis of the data indicated that as truck weight increased, truck speed decreased slightly. However, it was found that the weight of the truck only accounted for a small portion of the variability in truck speeds.

The average speeds for trucks were lower than the values for the previous study. However, the trend in average speed still seems to be increasing with the trend for heavier trucks on four-lane highways tending to level near the speed limit.

TRAFFIC SPEED REPORT NO. 82

During the months of August and September the Highway Planning Survey Section of the Indiana State Highway Commission conducted the annual study of truck weights on Indiana highways. The type of truck, weight, size, and material hauled were recorded at twenty-three stations throughout the state.

This report is an analysis of the 1965 truck weight-speed data collected by personnel of the Joint Highway Research Project in cooperation with personnel of the Indiana State Highway Commission. The truck weight-speed study compares the weight of a truck, obtained by the Planning Survey Section through the use of loadometer and pit scales, and the speed of the same truck, obtained by the personnel of the Joint Highway Research Project, using a radar meter. The radar unit was located approximately two miles from the weighing site. A positive identification method was used to match the truck weight with its associated speed.

Although the Highway Planning Survey Section made observations at twenty-three locations throughout the state, only ten stations were used for the collection of truck weight-speed data. The ten stations are shown on Figure 1 and described as follows:

<u>Station</u>	<u>Highway</u>	<u>Location</u>	<u>Date of Observation</u>	<u>No. of Lanes</u>
58B	U.S. 31	2000' S. of Southport Road	Aug. 24	4
75	U.S. 41	0.25 Mi. S. of U.S. 41 Business	Aug. 25	4
83	U.S. 41	0.5 Mi. N. of S.R. 37	Aug. 26	4
81	U.S. 150	0.3 Mi. S.E. of S.R. 57	Aug. 27	2

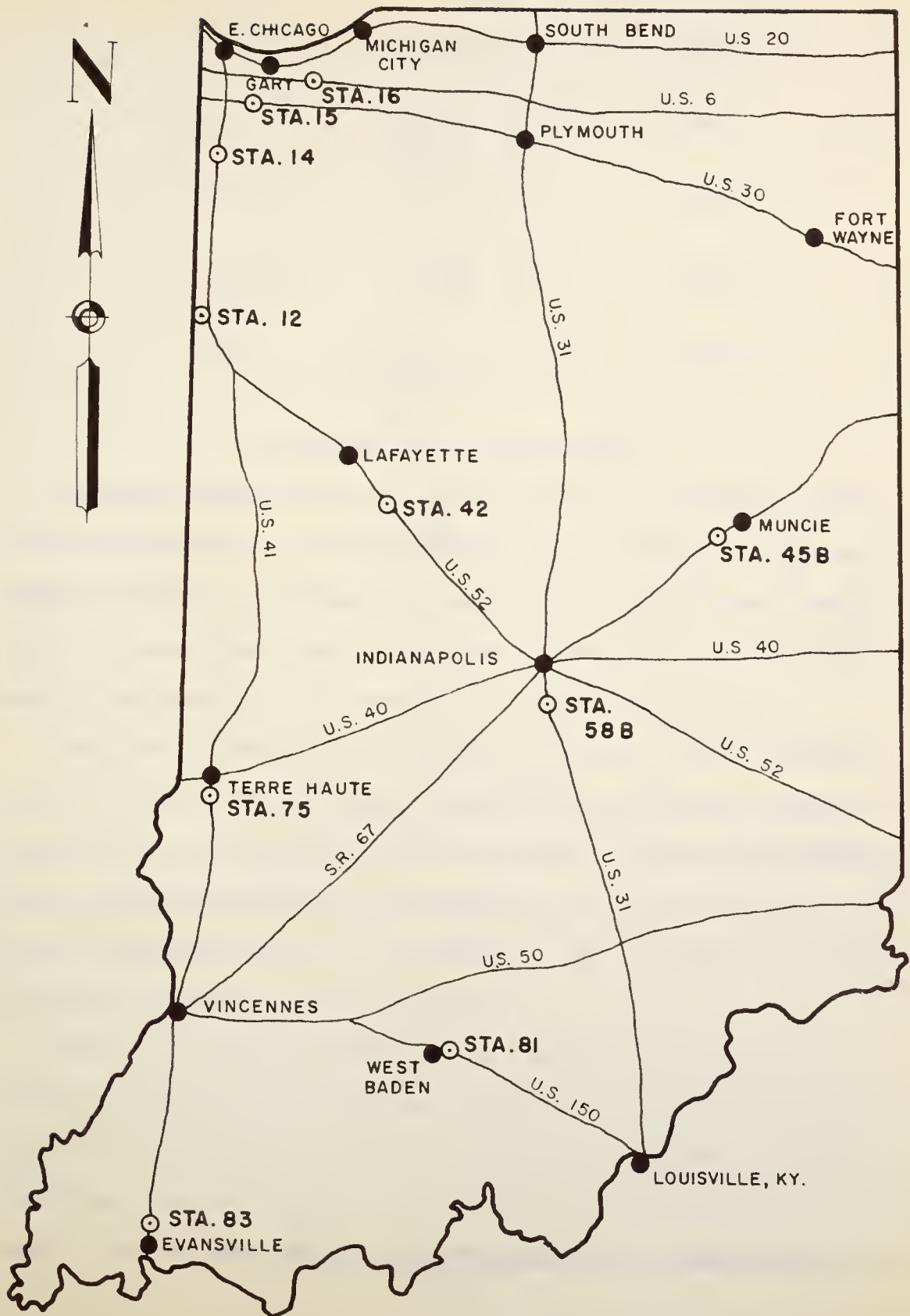


FIG. 1 LOCATIONS OF TRUCK WEIGHT-SPEED STATIONS

45B	S.R. 67	1.0 Mi. S.W. of Muncie	Sept. 2	2
16	U.S. 6	3.0 Mi. W. of S.R. 49	Sept. 13	2
15	U.S. 30	Between S. R. 55 and S.R. 53	Sept. 14	4
14	U.S. 41	0.5 Mi. S. of N. Jct. of S.R. 2	Sept. 15	4
12	U.S. 52	2.25 Mi. W. of U.S. 41	Sept. 16	2
42	U.S. 52	600' S.E. of N. Jct. of S.R. 28	Sept. 20	4

Equipment and Field Procedure

The speed observations were made on level tangent sections of the highways approximately two miles from the weight stations. In all cases sufficient distance was allowed for the trucks to regain normal cruising speeds. Care was also taken not to choose a location where the trucks might be influenced by an intersection or a railroad crossing.

The speeds of the trucks were obtained by the use of an "Electro-Matic" Radar Speed Meter, built by Automatic Signal Division, Eastman Industries, Inc., East Norwalk, Conn. The meter was placed approximately four feet from the edge of the pavement at an angle of less than 10 degrees with the highway centerline. For angles less than 10 degrees, the error in reading the vehicle speed is negligible.

Prior to beginning the study, a test using a "fifth wheel" was performed to determine the accuracy of the radar meter. The fifth wheel was checked for accuracy at a five-mile odometer check section and no significant errors were found in the instrument. The radar unit was found to have an error of less than 1/2 mile per hour; consequently, the

use of a calibration curve was deemed unnecessary. During the observations at a station, the radar meter was checked periodically with the 60 mile per hour tuning fork to assure the accuracy of the readings.

Each truck for which a speed was recorded was free flowing (the speed of the truck should not have been affected by other vehicles traveling in the same direction).

To avoid influencing the vehicles on the facility, the vehicle which was used in the study was not parked on the roadside at the observation station. The vehicle was parked on a side road in the vicinity of each station with an attempt to conceal it from the view of the passing vehicles.

The radar unit was placed on a platform in a green cardboard barrel, similar in size and color to the metal barrels used by the Indiana State Highway Department for roadside trash collection. The cable to the speed recording meter was stretched toward the roadside fence. In this manner, the personnel in the study were approximately 25 feet from the roadside and created a minimum influence on the passing trucks.

The truck weight-speed data were collected from 8 A.M. to 4 P.M. During the four A.M. hours the weights and speeds were recorded for trucks traveling in one direction, and during the four P.M. hours the information was recorded for trucks traveling in the opposite direction.

A positive method of identification was used to match the truck weights recorded with the truck speeds. At the weight stations, in addition to the weight of each truck, the name, the number of axles, the color of the cab and trailer, the time that the truck left the weight

The first of these is the fact that the system is not a simple one. It is a complex one, and it is one that is not easily understood. The second of these is the fact that the system is not a simple one. It is a complex one, and it is one that is not easily understood. The third of these is the fact that the system is not a simple one. It is a complex one, and it is one that is not easily understood. The fourth of these is the fact that the system is not a simple one. It is a complex one, and it is one that is not easily understood. The fifth of these is the fact that the system is not a simple one. It is a complex one, and it is one that is not easily understood. The sixth of these is the fact that the system is not a simple one. It is a complex one, and it is one that is not easily understood. The seventh of these is the fact that the system is not a simple one. It is a complex one, and it is one that is not easily understood. The eighth of these is the fact that the system is not a simple one. It is a complex one, and it is one that is not easily understood. The ninth of these is the fact that the system is not a simple one. It is a complex one, and it is one that is not easily understood. The tenth of these is the fact that the system is not a simple one. It is a complex one, and it is one that is not easily understood.

station, and any other identifying features were recorded. The same information was recorded for each truck that passed the radar unit. By estimating the time required to travel from the weight station to the radar unit and using the other identifying features, the truck weights were matched to the appropriate truck speed. If there was any doubt in the matching, the particular weight and speed were not used in the analysis.

Analysis

For the purpose of analysis the trucks were classified as single unit or multi-unit for each station. An analysis was made for each type of roadway, two-lane and four-lane. The single unit trucks were divided into those less than 5000 pounds and those 5000 pounds or greater. The weight classification corresponds to the Indiana speed limits:

65 MPH	for light trucks (less than 5000 pounds)
55 MPH	for heavy trucks (5000 pounds or more) on 4-lane highways with a median of 20 feet or more
50 MPH	for heavy trucks on other roadways

To determine the relationship between truck weight and truck speed for each classification of truck on each type of roadway, a linear equation was fitted to the data using regression techniques. A weighted regression analysis program (WRAP) was used for the regression analysis. The computations were performed using the 7094 computer at Purdue University.

Results of Analysis

The observed values for truck weights at each station were separated into 4,000 pound weight classes. Tables 1 and 2 show the number of trucks

Station		12			75		83		Total 4-lane		Total 2-lane and 4-lane	
					No. of Trucks	Ave Speed	No. of Trucks	Ave Speed	No. of Trucks	Ave Speed	No. of Trucks	Ave Speed
Weight (kips)		Ave Speed	No. of Trucks	Ave Speed	No. of Trucks	Ave Speed	No. of Trucks	Ave Speed	No. of Trucks	Ave Speed	No. of Trucks	
0-4		47.0	4	45.5	2	51.0	1	52.4	7	48.8	24	
4-5		52.6	5	55.7	10	50.6	10	51.1	36	51.3	61	
Light Trucks		9			12	11		43		85		
Ave. Wt. (lbs)		3,910			280	4,330		4,270		4,160		
Ave. Speed		50.1			50.2	50.6		51.4		50.6		
Conf Level		95			95	95		95		95		
Conf Limit	Upper	57.1			55.5	57.7		54.4		52.8		
	lower	43.1			44.9	43.5		48.4		48.4		
5-8		50.3	6	46.6	27	49.9	15	50.6	80	50.2	109	
8-12		47.4	5	46.5	19	46.3	15	49.1	87	48.7	130	
12-16		49.5	2	44.3	12	49.8	13	50.3	58	49.8	85	
16-20		48.5	2	51.0	8	54.0	3	48.2	40	48.0	54	
20-24		50.0	1	51.0	3	52.5	2	49.1	16	48.5	21	
24-28		----	---	44.5	2	----	---	50.2	6	50.0	7	
28-32		45.0	1	44.0	1	51.8	4	47.9	9	47.9	13	
32-36		----	---	44.5	4	----	---	47.4	12	47.4	12	
36-40		----	---	44.0	2	48.3	3	48.3	10	47.7	18	
40-44		----	---	44.0	1	51.0	1	47.5	4	46.6	5	
44-48		----	---	44.0	---	----	---	62.0	1	61.0	1	
48-52		----	---	44.0	---	----	---	----	---	----	---	
52-56		----	---	44.0	---	----	---	35.0	1	35.0	1	
56-60		----	---	44.0	---	----	---	46.5	4	46.5	2	
60-64		----	---	44.0	---	----	---	----	---	----	---	
64-68		----	---	44.0	---	----	---	----	---	----	---	
68-72		----	---	44.0	---	----	---	----	---	----	---	
72-76		----	---	44.0	---	----	---	----	---	----	---	
Heavy Trucks		17			79	56		326		458		
Ave. Wt (lbs)		11,990			8,460	14,300		14,810		14,500		
Ave. Speed		48.8			47.1	49.3		49.4		49.0		
Conf Level		95			95	95		95		95		
Conf Limit	Upper	52.8			49.0	51.4		50.4		50.1		
	Lower	43.3			45.2	47.2		48.4		47.9		

TABLE 1 - SINGLE UNIT TRUCK SPEEDS (MPH)

Station		Two-lane Highways										Four-lane Highways														Total 2-lane and 4-lane	
		12		16		45B		81		Total 2-lane		14		15		42		58B		75		83		Total 4-lane			
Weight (kips)	Ave Speed	No. of Trucks	Ave Speed	No. of Trucks	Ave Speed	No. of Trucks	Ave Speed	No. of Trucks	Ave Speed	No. of Trucks	Ave Speed	No. of Trucks	Ave Speed	No. of Trucks	Ave Speed	No. of Trucks	Ave Speed	No. of Trucks	Ave Speed	No. of Trucks	Ave Speed	No. of Trucks	Ave Speed	No. of Trucks	Ave Speed	No. of Trucks	
0-4	47.0	4	45.3	3	50.7	6	44.3	4	47.4	17	----	---	28.0	2	54.0	1	53.0	1	52.5	2	51.0	1	52.4	7	48.8	24	
4-5	52.6	5	55.5	2	50.1	7	50.9	11	51.4	25	49.5	2	51.2	6	53.0	4	51.8	4	49.7	10	50.6	10	51.1	36	51.3	61	
Light Trucks		9		5		13		15		42		2		5		5		5		12		11		43		35	
Ave. Wt. (lbs)		3,910		3,820		4,050		4,200		4,050		3,500		4,210		4,120		4,240		4,280		4,330		4,270		4,160	
Ave. Speed		50.1		49.4		50.4		49.1		49.8		45.5		49.0		53.2		52.0		50.2		50.6		51.4		50.6	
Conf Level		95		95		95		95		95		95		95		95		95		95		95		95		95	
Conf	Upper	57.1		63.4		55.0		53.2		53.2		---		59.5		53.5		60.0		55.5		57.7		54.4		58.8	
Limit	lower	43.1		35.4		45.8		45.0		44.4		---		44.5		42.9		44.0		44.9		43.5		48.4		48.4	
5-8	50.3	6	46.7	3	49.2	10	49.4	10	49.2	20	55.7	7	52.2	10	50.0	13	46.5	8	47.6	27	49.9	15	50.6	30	50.2	109	
8-12	47.4	5	46.2	4	48.8	16	48.0	13	48.1	43	51.1	12	55.0	8	51.7	16	45.3	17	48.5	19	46.3	15	49.1	87	48.7	130	
12-16	49.5	2	45.6	5	50.5	10	48.0	0	48.6	27	48.0	5	51.4	7	52.0	11	48.4	10	50.3	12	49.8	13	50.3	58	49.8	85	
16-20	48.5	2	51.0	2	50.3	3	44.9	7	47.4	14	44.0	8	51.0	5	51.6	7	45.8	9	42.0	3	54.0	3	48.2	40	48.0	54	
20-24	50.0	1	----	----	----	----	45.5	4	46.4	5	44.0	2	52.1	3	51.3	3	45.7	3	43.0	3	52.5	2	49.1	16	48.5	21	
24-28	----	---	44.0	1	----	----	----	----	49.0	1	51.0	1	----	----	52.0	2	59.0	1	47.5	2	----	---	50.2	6	50.0	7	
28-32	45.0	1	49.0	1	54.0	1	43.0	1	47.8	4	62.0	1	----	----	38.0	1	41.0	2	43.0	1	51.8	4	47.9	9	47.9	13	
32-36	----	---	----	---	----	----	----	----	----	----	51.5	2	51.0	2	42.0	2	41.0	2	46.5	4	----	---	47.4	12	47.4	12	
36-40	----	---	40.5	2	38.0	1	41.2	5	40.6	8	47.7	3	----	----	53.0	1	46.0	1	51.0	2	48.3	3	48.3	10	44.9	18	
40-44	----	---	----	---	----	----	43.0	1	43.0	1	51.0	1	----	----	52.0	1	----	---	36.0	1	51.0	1	47.5	4	46.6	5	
44-48	----	---	----	---	----	----	----	----	----	----	----	----	----	----	----	----	62.0	1	----	---	----	---	62.0	1	62.0	1	
48-52	----	---	----	---	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	
52-56	----	---	----	---	----	----	----	----	----	----	----	----	----	----	----	----	35.0	1	----	---	----	---	35.0	1	35.0	1	
56-60	----	---	----	---	----	----	----	----	----	----	----	----	----	----	----	----	40.5	2	----	---	----	---	46.5	4	40.5	2	
60-64	----	---	----	---	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	
64-68	----	---	----	---	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	
68-72	----	---	----	---	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	
72-76	----	---	----	---	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	
Heavy Trucks		17		18		41		56		132		42		35		57		57		79		56		326		458	
Ave. Wt (lbs)		11,990		16,490		11,620		14,910		13,730		16,680		13,430		14,120		17,320		13,460		14,300		14,810		14,500	
Ave. Speed		48.8		46.3		49.3		46.9		47.8		50.2		52.6		52.8		46.2		47.1		49.3		49.4		49.0	
Conf Level		95		95		95		95		95		95		95		95		95		95		95		95		95	
Conf	Upper	53.8		50.1		51.7		49.7		49.6		54.4		55.9		55.9		48.2		49.0		51.4		50.4		50.1	
Limit	Lower	43.3		42.5		46.9		44.1		44.1		47.4		49.3		49.7		44.2		45.2		47.2		48.4		47.9	

Station									Total		
		12			75	83		Total Four-lane		2-lane and 4-lane	
Weight (kips)		Ave. Speed	No. of Trucks	Ave Speed	No. of Trucks	Ave. Speed	No. of Trucks	Ave. Speed	No. of Trucks	Ave. Speed	No. of Trucks
8-12		45.0	1	---	---	---	---	---	---	45.0	1
12-16		49.0	1	51.0	---	---	---	49.5	4	49.9	7
16-20		46.5	2	49.0	3	50.7	3	50.8	24	49.9	33
20-24		50.5	4	52.4	8	49.2	12	50.8	75	50.5	94
24-28		54.0	1	52.1	18	52.6	11	53.0	106	52.3	131
28-32		44.5	4	41.1	15	52.8	5	52.8	109	52.2	128
32-36		44.5	2	47.1	4	48.8	4	52.9	69	52.4	77
36-40		50.0	1	48.4	3	51.3	4	52.1	47	51.2	66
40-44		---	---	50.4	2	47.2	6	51.1	41	50.9	54
44-48		---	---	52.1	2	54.0	2	52.0	37	52.2	45
48-52		---	---	53.2	6	53.4	5	49.2	45	50.1	59
52-56		42.7	3	52.1	5	53.5	2	49.1	41	49.0	53
56-60		---	---	50.2	6	51.4	11	50.7	54	50.5	67
60-64		47.0	1	53.1	3	52.5	2	50.6	34	50.1	52
64-68		---	---	49.1	5	53.3	6	49.8	57	49.4	72
68-72		---	---	50.4	6	50.9	17	49.8	79	50.0	92
72-76		45.0	1	55.0	8	50.8	6	49.8	69	49.0	76
76-80		---	---	---	11	---	---	47.3	42	47.4	47
80-84		---	---	---	---	---	---	41.2	10	49.5	11
84-88		---	---	---	---	---	---	---	---	---	---
88-92		---	---	---	---	---	---	---	---	---	---
92-96		---	---	---	---	---	---	---	---	---	---
96-100		---	---	---	---	---	---	---	---	---	---
Total Trucks		21		95		96		943		1165	
Ave Wt (lbs)		33,140		47,90		47,270		46,480		46,070	
Ave Speed		47.9		51.5		51.3		50.9		50.7	
Conf. level		95		95		95		95		95	
Conf.	Upper	52.6		51.4		52.7		51.6		51.3	
Limit	Lower	43.2		49.6		49.9		50.2		50.1	

TABLE 2 - MULTI-UNIT TRUCK SPEEDS (MPH)

Station	Two-lane Highways										Four-lane Highways												Total 2-lane and 4-lane			
	12		16		45B		81		Total Two-lane		14		15		42		58B		75		83		Total Four-lane		Ave. Speed	No. of Trucks
Weight (kips)	Ave. Speed	No. of Trucks	Ave. Speed	No. of Trucks	Ave. Speed	No. of Trucks	Ave. Speed	No. of Trucks	Ave. Speed	No. of Trucks	Ave. Speed	No. of Trucks	Ave. Speed	No. of Trucks	Ave. Speed	No. of Trucks	Ave. Speed	No. of Trucks	Ave. Speed	No. of Trucks	Ave. Speed	No. of Trucks	Ave. Speed	No. of Trucks		
8-12	45.0	1	----	---	----	---	----	---	45.0	1	----	---	----	---	----	---	----	---	----	---	----	---	----	---	45.0	1
12-16	49.0	1	51.0	2	----	---	----	---	50.3	3	49.0	2	----	---	52.0	1	47.0	1	----	---	----	---	49.5	4	49.9	7
16-20	46.5	2	49.0	4	37.0	1	51.0	2	47.6	9	47.0	5	51.7	6	52.6	5	50.0	2	52.3	3	50.7	3	50.8	24	49.9	33
20-24	50.5	4	52.4	8	45.2	4	46.7	3	49.6	19	50.9	13	51.5	19	52.5	12	46.9	11	49.3	8	49.2	12	50.2	75	50.5	94
24-28	54.0	1	52.3	11	52.4	8	50.8	5	52.1	25	51.0	16	54.1	23	52.8	17	52.1	21	53.2	18	52.6	11	52.0	106	52.0	131
28-32	47.5	4	47.3	4	51.3	6	47.2	5	48.6	19	52.7	30	54.4	16	53.0	27	50.3	16	51.5	15	52.8	5	52.2	109	52.2	128
32-36	47.5	2	47.7	3	47.5	2	48.0	1	48.1	8	54.0	23	56.6	11	52.9	15	49.5	12	50.0	4	48.8	4	52.9	69	52.4	77
36-40	50.0	1	48.4	8	49.3	9	47.0	1	48.3	19	52.5	16	52.4	5	55.7	10	49.7	9	49.7	3	51.3	4	52.1	47	51.2	66
40-44	----	---	50.4	10	50.5	2	46.0	1	50.1	13	50.5	10	54.6	10	53.8	8	45.0	5	43.5	2	47.2	6	51.1	41	50.9	54
44-48	----	---	52.5	6	50.5	2	----	---	53.3	8	52.9	10	53.2	13	47.7	6	53.3	4	42.0	2	54.0	2	52.0	37	52.2	45
48-52	----	---	52.1	9	52.0	2	49.3	3	52.0	14	47.0	9	52.9	7	49.2	5	46.8	13	46.0	6	52.4	5	49.2	45	50.1	59
52-56	47.7	3	52.7	7	40.0	1	49.0	1	48.0	12	49.0	11	51.3	8	51.0	9	47.2	6	42.0	5	53.5	2	49.1	41	49.0	53
56-60	----	---	50.2	10	49.0	2	51.0	1	50.1	13	50.0	12	52.4	7	50.1	12	50.5	6	48.2	6	51.4	11	50.7	54	50.5	67
60-64	47.0	1	51.7	13	----	---	47.3	4	49.3	18	51.5	10	52.8	5	52.3	7	44.4	7	52.7	3	52.5	2	50.6	34	50.1	52
64-68	----	---	49.5	12	41.5	2	42.0	1	48.0	15	48.1	13	51.9	15	49.5	8	45.9	10	51.6	5	53.3	6	49.8	57	49.4	72
68-72	----	---	50.4	9	51.0	3	56.0	1	51.0	13	50.0	15	51.3	15	50.5	17	44.3	9	47.5	6	50.9	17	49.8	79	50.0	92
72-76	47.0	1	55.0	2	48.5	2	49.0	2	50.0	7	48.0	23	52.5	10	47.1	7	45.9	15	50.0	8	50.8	6	49.8	69	49.0	76
76-80	----	---	----	---	51.0	3	45.0	2	48.6	5	47.0	11	50.0	1	48.4	11	44.4	8	46.7	11	----	---	47.3	42	47.4	47
80-84	----	---	----	---	----	---	52.0	1	52.0	1	50.3	3	----	---	48.7	6	43.0	1	----	---	----	---	47.2	10	49.5	11
84-88	----	---	----	---	----	---	----	---	----	---	----	---	----	---	----	---	----	---	----	---	----	---	----	---	----	---
88-92	----	---	----	---	----	---	----	---	----	---	----	---	----	---	----	---	----	---	----	---	----	---	----	---	----	---
92-96	----	---	----	---	----	---	----	---	----	---	----	---	----	---	----	---	----	---	----	---	----	---	----	---	----	---
96-100	----	---	----	---	----	---	----	---	----	---	----	---	----	---	----	---	----	---	----	---	----	---	----	---	----	---
Total Trucks	21		116		49		34		222		232		171		183		156		105		96		943		1165	
Ave Wt (lbs)	33,140		47,150		42,140		44,620		44,330		47,590		43,950		46,720		46,850		46,490		47,270		46,480		46,070	
Ave Speed	47.9		51.0		49.6		47.9		49.9		51.2		53.3		51.5		48.0		49.5		51.3		50.9		50.7	
Conf. level	95		95		95		95		95		95		95		95		95		95		95		95		95	
Conf. Upper	52.6		52.0		52.3		51.5		51.3		51.0		54.3		52.7		48.8		51.4		52.7		51.6		51.3	
Limit Lower	43.2		49.0		46.9		44.3		48.5		50.4		52.3		50.3		47.2		47.6		49.9		50.2		50.1	

and the average speed for each weight class. The tables also show the average speed for each classification of trucks at each station and summaries of the same values for each roadway type. The results for each truck classification and roadway type are as follows:

Single Unit (less than 5000 pounds)

	2-lane	4-lane	all
No. of vehicles	42	43	85
Average Speed - MPH	49.8	51.4	50.6
Average Weight - lbs	4,050	4,270	4,160

Single Unit (5000 lbs or more)

	2-lane	4-lane	all
Number of trucks	132	326	458
Average Speed - MPH	47.8	49.4	49.0
Average Weight - lbs	13,730	14,810	14,500

Multi-Unit

	2-lane	4-lane	all
Number of trucks	222	943	1165
Average Speed - MPH	49.9	50.9	50.7
Average Weight - lbs	44,330	46,480	46,070

The values in Table 3 are the percent of trucks exceeding the speed limit and the percent exceeding 5 miles above the speed limit for each station. The following chart summarizes the results in Table 3.

Single Unit

	light	heavy	Multi-Unit
2-lane			
Speed Limit	2.4	31.1	48.6
5 MPH above limit	0.0	6.1	9.0
4-lane			
Speed limit	4.6	18.4	17.8
5 MPH above limit	0.0	5.2	1.9

SINGLE UNIT TRUCKS				MULTIPLE UNIT TRUCKS			
Sta.	Trucks Weighting Under 5000 lbs		Trucks Weighting over 5000 lbs		All Weights		
	No Trucks observed	% exceeding 65 MPH	% exceeding 70 MPH	No Trucks observed	% exceeding 50 MPH	% exceeding 55 MPH	% exceeding 55 MPH
Two-lane Highways 12 16 45B 81	9	11.1	0.0	17	35.3	0.0	0.0
	5	0.0	0.0	18	16.7	0.0	11.9
	13	0.0	0.0	41	46.3	12.2	8.2
	15	0.0	0.0	56	23.3	5.4	5.9
All 2 lane	42	2.4	0.0	132	31.1	6.1	9.0
Four-lane Highways 14 15 42 58B 75 83	2	50.0	0.0	42	26.2	7.1	1.7
	8	12.5	0.0	35	25.7	2.9	2.3
	5	0.0	0.0	57	36.8	12.3	1.6
	5	0.0	0.0	57	5.3	1.7	1.3
	12	0.0	0.0	79	12.7	3.8	4.8
	11	0.0	0.0	56	10.3	3.6	0.0
All 4 lane	43	4.6	0.0	326	18.4	5.2	1.9
Summary	85	3.5	0.0	458	—	—	—

TABLE 3

PERCENTAGE OF TRUCKS VIOLATING SPEED LIMITS

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	153	154	155	156	157	158	159	160	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180	181	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200	201	202	203	204	205	206	207	208	209	210	211	212	213	214	215	216	217	218	219	220	221	222	223	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239	240	241	242	243	244	245	246	247	248	249	250	251	252	253	254	255	256	257	258	259	260	261	262	263	264	265	266	267	268	269	270	271	272	273	274	275	276	277	278	279	280	281	282	283	284	285	286	287	288	289	290	291	292	293	294	295	296	297	298	299	300	301	302	303	304	305	306	307	308	309	310	311	312	313	314	315	316	317	318	319	320	321	322	323	324	325	326	327	328	329	330	331	332	333	334	335	336	337	338	339	340	341	342	343	344	345	346	347	348	349	350	351	352	353	354	355	356	357	358	359	360	361	362	363	364	365	366	367	368	369	370	371	372	373	374	375	376	377	378	379	380	381	382	383	384	385	386	387	388	389	390	391	392	393	394	395	396	397	398	399	400	401	402	403	404	405	406	407	408	409	410	411	412	413	414	415	416	417	418	419	420	421	422	423	424	425	426	427	428	429	430	431	432	433	434	435	436	437	438	439	440	441	442	443	444	445	446	447	448	449	450	451	452	453	454	455	456	457	458	459	460	461	462	463	464	465	466	467	468	469	470	471	472	473	474	475	476	477	478	479	480	481	482	483	484	485	486	487	488	489	490	491	492	493	494	495	496	497	498	499	500	501	502	503	504	505	506	507	508	509	510	511	512	513	514	515	516	517	518	519	520	521	522	523	524	525	526	527	528	529	530	531	532	533	534	535	536	537	538	539	540	541	542	543	544	545	546	547	548	549	550	551	552	553	554	555	556	557	558	559	560	561	562	563	564	565	566	567	568	569	570	571	572	573	574	575	576	577	578	579	580	581	582	583	584	585	586	587	588	589	590	591	592	593	594	595	596	597	598	599	600	601	602	603	604	605	606	607	608	609	610	611	612	613	614	615	616	617	618	619	620	621	622	623	624	625	626	627	628	629	630	631	632	633	634	635	636	637	638	639	640	641	642	643	644	645	646	647	648	649	650	651	652	653	654	655	656	657	658	659	660	661	662	663	664	665	666	667	668	669	670	671	672	673	674	675	676	677	678	679	680	681	682	683	684	685	686	687	688	689	690	691	692	693	694	695	696	697	698	699	700	701	702	703	704	705	706	707	708	709	710	711	712	713	714	715	716	717	718	719	720	721	722	723	724	725	726	727	728	729	730	731	732	733	734	735	736	737	738	739	740	741	742	743	744	745	746	747	748	749	750	751	752	753	754	755	756	757	758	759	760	761	762	763	764	765	766	767	768	769	770	771	772	773	774	775	776	777	778	779	780	781	782	783	784	785	786	787	788	789	790	791	792	793	794	795	796	797	798	799	800	801	802	803	804	805	806	807	808	809	810	811	812	813	814	815	816	817	818	819	820	821	822	823	824	825	826	827	828	829	830	831	832	833	834	835	836	837	838	839	840	841	842	843	844	845	846	847	848	849	850	851	852	853	854	855	856	857	858	859	860	861	862	863	864	865	866	867	868	869	870	871	872	873	874	875	876	877	878	879	880	881	882	883	884	885	886	887	888	889	890	891	892	893	894	895	896	897	898	899	900	901	902	903	904	905	906	907	908	909	910	911	912	913	914	915	916	917	918	919	920	921	922	923	924	925	926	927	928	929	930	931	932	933	934	935	936	937	938	939	940	941	942	943	944	945	946	947	948	949	950	951	952	953	954	955	956	957	958	959	960	961	962	963	964	965	966	967	968	969	970	971	972	973	974	975	976	977	978	979	980	981	982	983	984	985	986	987	988	989	990	991	992	993	994	995	996	997	998	999	1000	1001	1002	1003	1004	1005	1006	1007	1008	1009	1010	1011	1012	1013	1014	1015	1016	1017	1018	1019	1020	1021	1022	1023	1024	1025	1026	1027	1028	1029	1030	1031	1032	1033	1034	1035	1036	1037	1038	1039	1040	1041	1042	1043	1044	1045	1046	1047	1048	1049	1050	1051	1052	1053	1054	1055	1056	1057	1058	1059	1060	1061	1062	1063	1064	1065	1066	1067	1068	1069	1070	1071	1072	1073	1074	1075	1076	1077	1078	1079	1080	1081	1082	1083	1084	1085	1086	1087	1088	1089	1090	1091	1092	1093	1094	1095	1096	1097	1098	1099	1100	1101	1102	1103	1104	1105	1106	1107	1108	1109	1110	1111	1112	1113	1114	1115	1116	1117	1118	1119	1120	1121	1122	1123	1124	1125	1126	1127	1128	1129	1130	1131	1132	1133	1134	1135	1136	1137	1138	1139	1140	1141	1142	1143	1144	1145	1146	1147	1148	1149	1150	1151	1152	1153	1154	1155	1156	1157	1158	1159	1160	1161	1162	1163	1164	1165	1166	1167	1168	1169	1170	1171	1172	1173	1174	1175	1176	1177	1178	1179	1180	1181	1182	1183	1184	1185	1186	1187	1188	1189	1190	1191	1192	1193	1194	1195	1196	1197	1198	1199	1200	1201	1202	1203	1204	1205	1206	1207	1208	1209	1210	1211	1212	1213	1214	1215	1216	1217	1218	1219	1220	1221	12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Table 4 lists the number of observations, average speed, and average weight for each truck classification for the past seventeen years.

Figures 2, 3 and 4 show graphically the accumulative speed distribution for each classification of truck on two-lane, four-lane, and the combination of both roadway types. Figures 5 and 6 show the trends in the 85th percentile truck speed for two-lane and four-lane roadways for the past twelve years.

Figures 7 and 8 show the relationship between truck weight and speed for single unit and multi-unit trucks on each type of roadway. The weight-speed relationships for all single unit and multi-unit trucks observed are shown in Figure 9.

Summary and Conclusions

The linear equations derived for the relationship between truck weight and truck speed, Figures 7, 8 and 9, indicate that as truck weight increases, truck speed decreases. However, the coefficients of linear association, "r", were small, indicating that the data have a small relation to a linear equation or that there is a great deal of scatter in the data. The coefficients of determination, " r^2 ", were also small. This coefficient expresses the percent of the variability in the data which the equation explains.

The coefficients computed for each classification of truck on each type of roadway were as follows:

<u>Equation</u>	<u>r</u>	<u>r^2</u>
2-lane single unit	0.3030	0.0918
4-lane single unit	0.1320	0.0174
2-lane multi-unit	0.0084	0.0001
4-lane multi-unit	0.2516	0.0633

Year	Single-Unit			Multi-Unit		
	Number	Average Speed	Average Weight	Number	Average Speed	Average Weight
1949	578	42.2	9,400	581	43.2	32,500
1950	791	42.4	8,700	879	42.7	36,700
1951	1,242	43.0	8,600	1,402	43.5	36,700
1952	1,482	43.4	8,700	1,354	44.1	35,900
1953	1,239	43.9	8,400	1,507	43.1	35,800
1954	905	45.8	8,000	1,064	43.6	37,400
1955	762	45.9	8,900	1,120	43.5	38,400
1956	952	47.0	8,300	1,033	44.4	37,900
1957	1,028	46.3	9,400	1,161	42.5	37,100
1958	837	46.5	9,900	1,130	46.1	39,500
1959	481	45.5	9,200	604	48.6	40,300
1960	424	49.1	12,000	644	50.3	39,300
1961	938	48.0	10,600	1,149	48.6	42,600
1962	610	48.7	11,800	1,079	49.2	42,700
1963	488	44.9	11,500	736	45.9	43,600
1964	677	50.6	11,200	1,176	51.1	44,100
1965	543	49.2	12,900	1,165	50.7	46,100

TABLE 4

TRUCK-WEIGHT SPEED DATA
COMPARISON OF DATA FROM STUDIES IN VARIOUS YEARS

表 1 某公司 2018 年 1 月 1 日至 12 月 31 日止的现金流量表

项目	金额	外币金额	人民币金额
一、经营活动产生的现金流量			
1. 销售商品、提供劳务收到的现金	10000000	10000000	10000000
2. 收到的税费返还	100000	100000	100000
3. 收到其他与经营活动有关的现金	100000	100000	100000
4. 购买商品、接受劳务支付的现金	(8000000)	(8000000)	(8000000)
5. 支付给职工以及为职工支付的现金	(1000000)	(1000000)	(1000000)
6. 支付的各项税费	(500000)	(500000)	(500000)
7. 支付其他与经营活动有关的现金	(100000)	(100000)	(100000)
经营活动产生的现金流量净额	1500000	1500000	1500000
二、投资活动产生的现金流量			
1. 收回投资收到的现金	1000000	1000000	1000000
2. 取得投资收益收到的现金	100000	100000	100000
3. 处置固定资产、无形资产和其他长期资产收回的现金净额	100000	100000	100000
4. 处置子公司及其他营业单位收到的现金净额	100000	100000	100000
5. 收到其他与投资活动有关的现金	100000	100000	100000
6. 购建固定资产、无形资产和其他长期资产支付的现金	(1000000)	(1000000)	(1000000)
7. 投资支付的现金	(1000000)	(1000000)	(1000000)
8. 支付其他与投资活动有关的现金	(100000)	(100000)	(100000)
投资活动产生的现金流量净额	(1000000)	(1000000)	(1000000)
三、筹资活动产生的现金流量			
1. 吸收投资收到的现金	1000000	1000000	1000000
2. 取得借款收到的现金	1000000	1000000	1000000
3. 发行债券收到的现金	1000000	1000000	1000000
4. 收到其他与筹资活动有关的现金	100000	100000	100000
5. 偿还债务支付的现金	(1000000)	(1000000)	(1000000)
6. 分配股利、利润或偿付利息支付的现金	(1000000)	(1000000)	(1000000)
7. 支付其他与筹资活动有关的现金	(100000)	(100000)	(100000)
筹资活动产生的现金流量净额	1000000	1000000	1000000
四、汇率变动对现金及现金等价物的影响	100000	100000	100000
五、现金及现金等价物净增加额	1500000	1500000	1500000
六、期初现金及现金等价物余额	1000000	1000000	1000000
七、期末现金及现金等价物余额	2500000	2500000	2500000

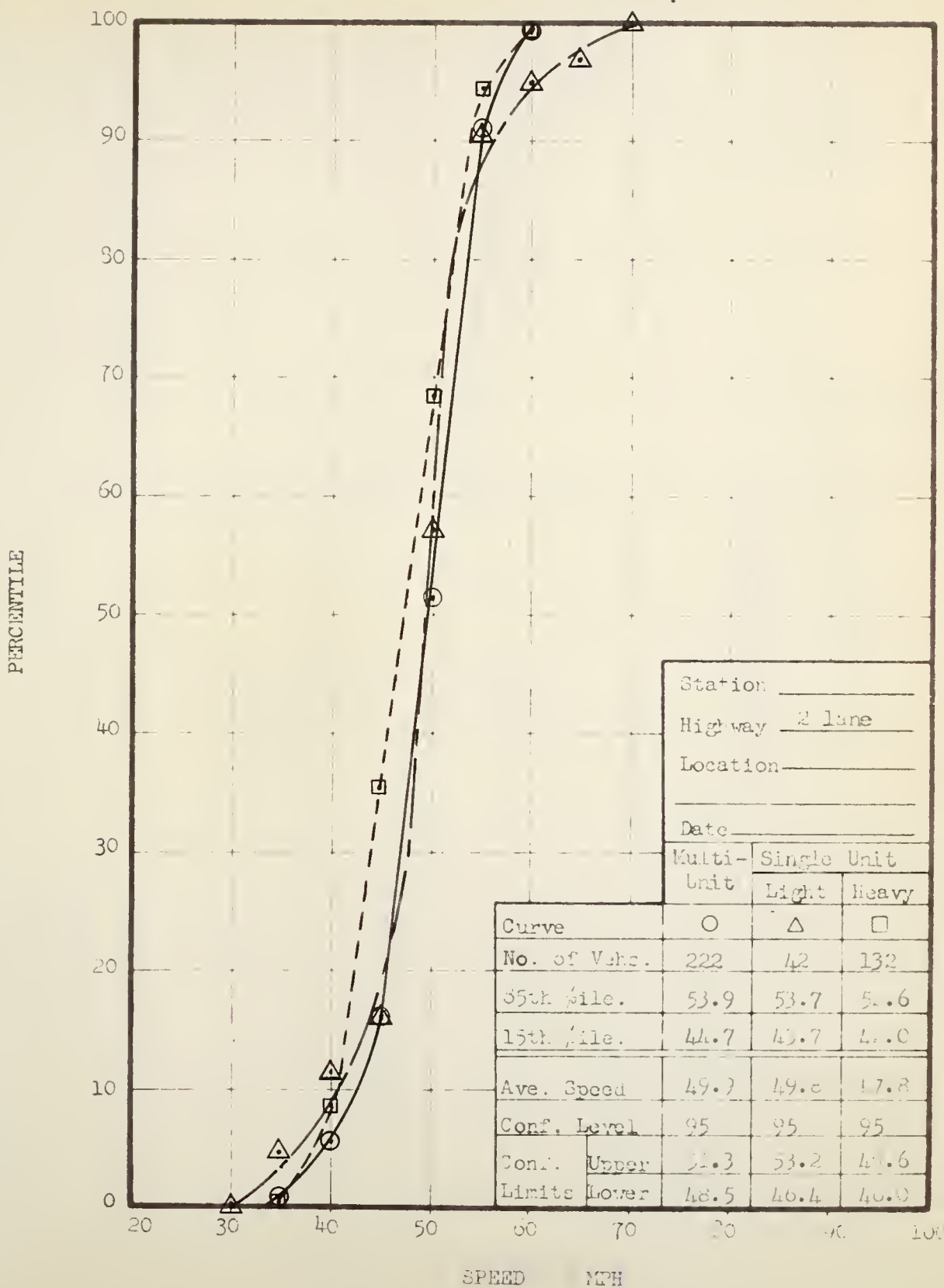


FIGURE 2. ACCUMULATIVE SPEED CURVES

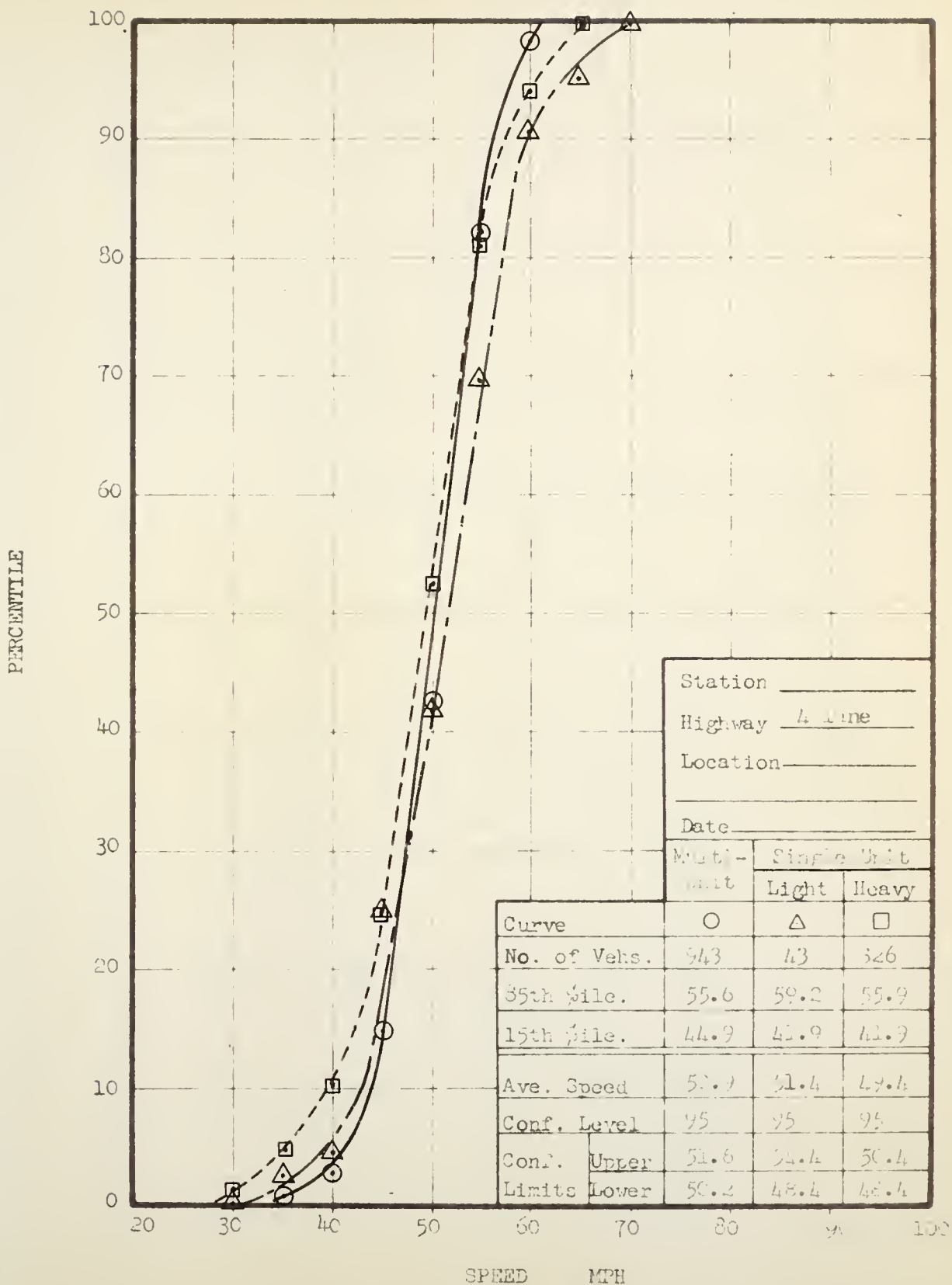


FIGURE 3. ACCELERATIVE SPEED CURVES

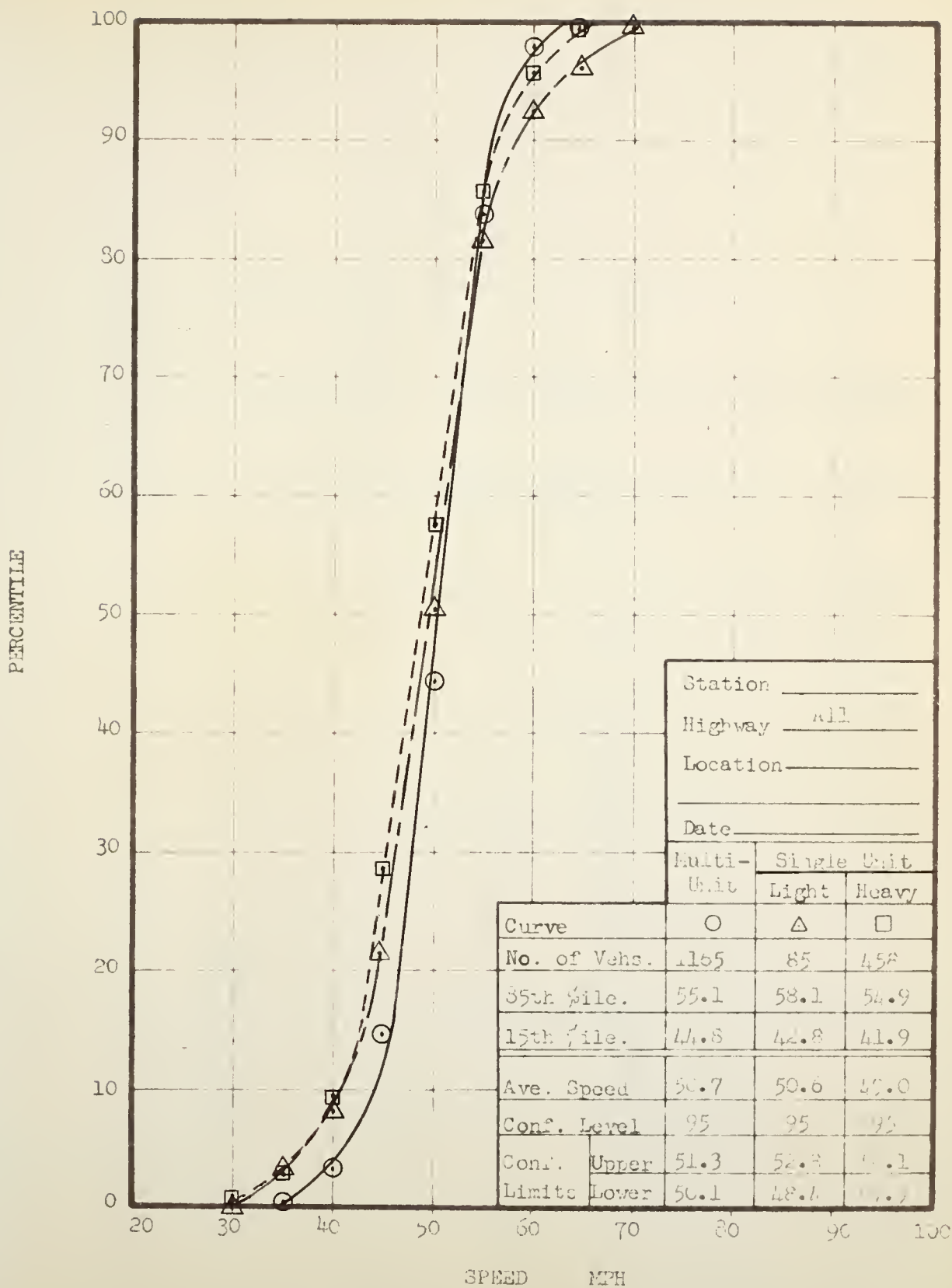


FIGURE 4. ACCUMULATIVE SPEED CURVES

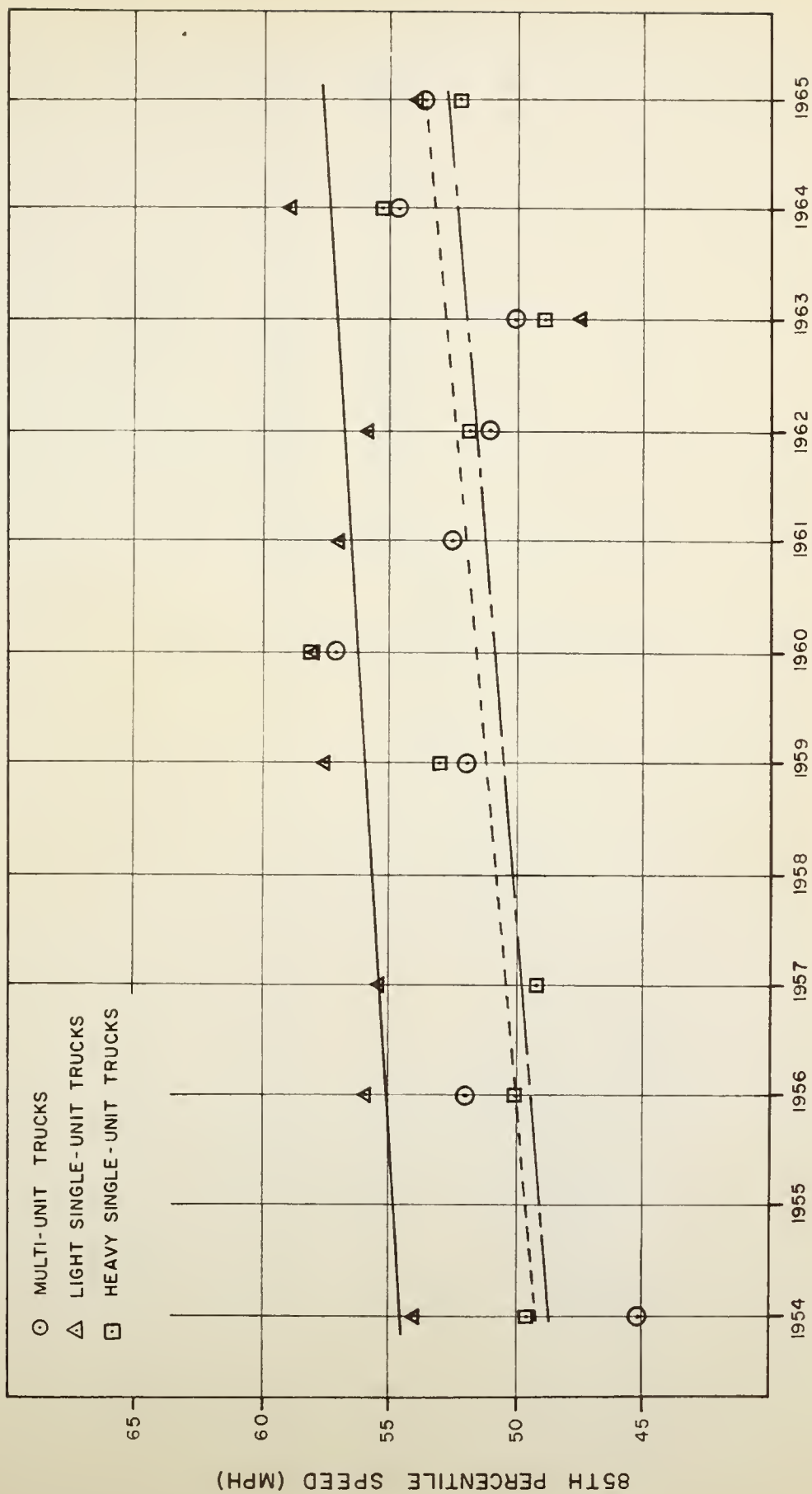


FIG. 5 - TRENDS IN THE 85TH PERCENTILE TRUCK SPEED ON TWO-LANE HIGHWAYS (1954-1965)

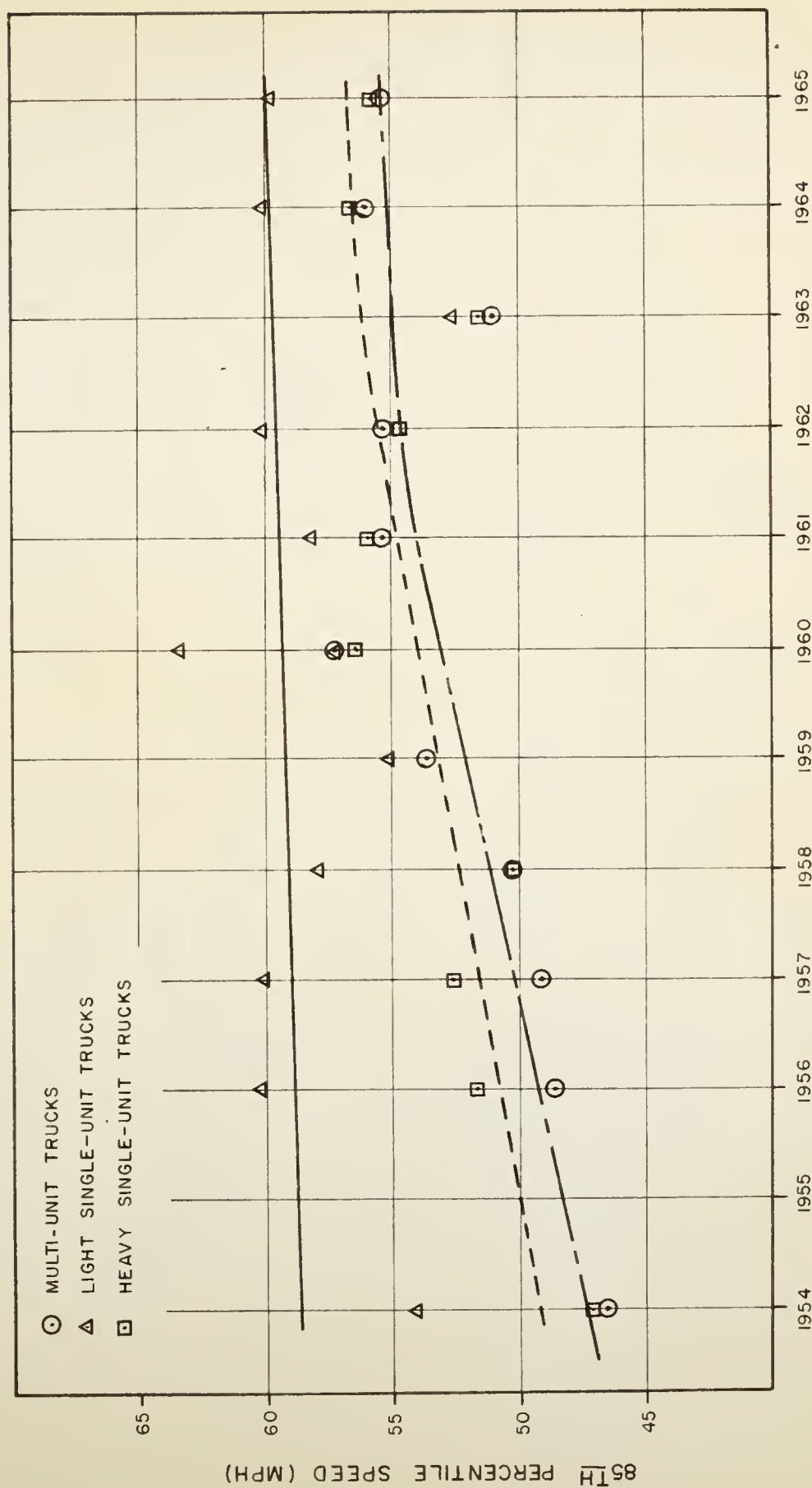


FIG. 6 - TRENDS IN THE 85TH PERCENTILE TRUCK SPEED ON FOUR-LANE HIGHWAYS (1954-1965)

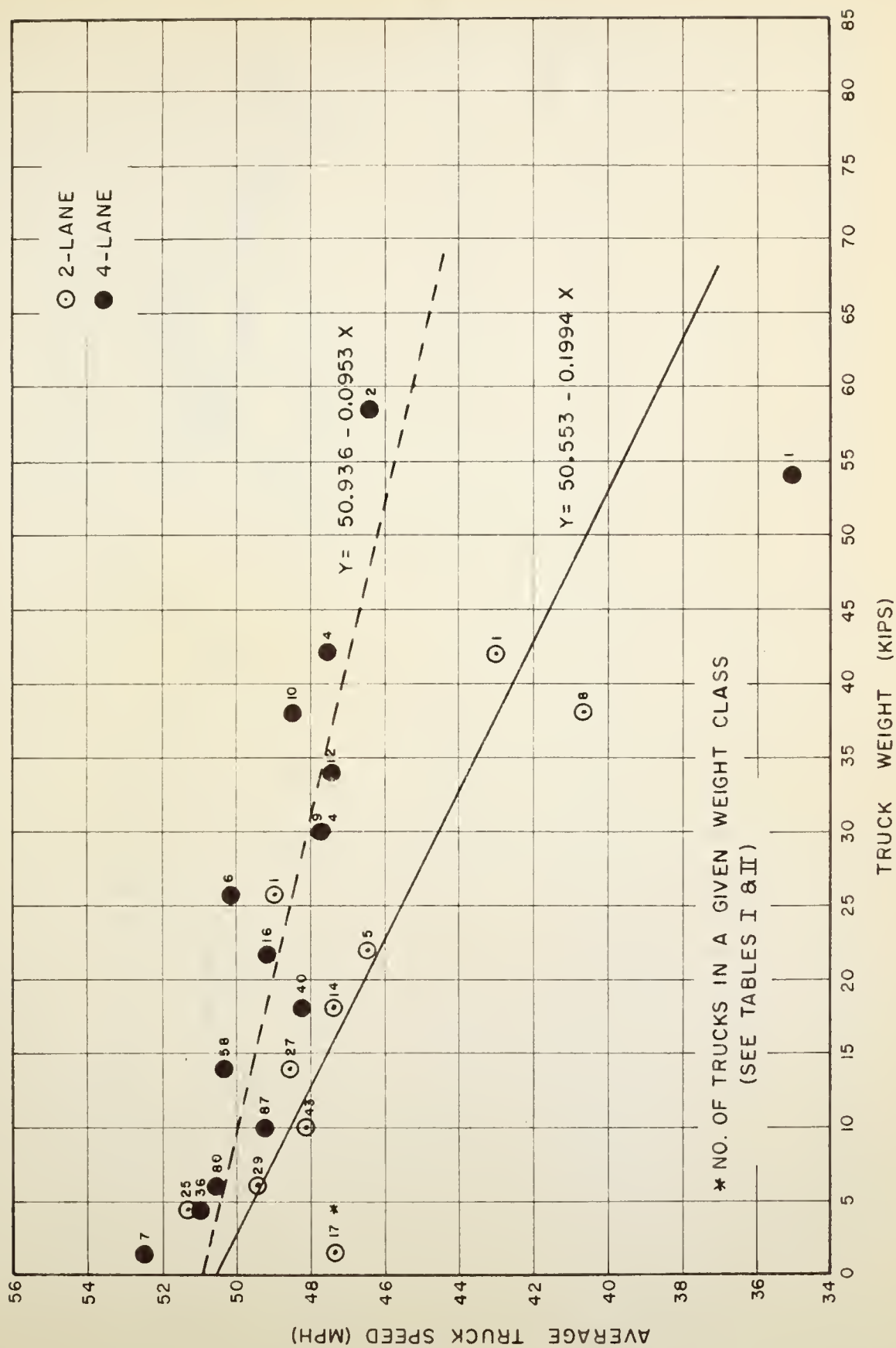


FIG. 7 - REGRESSION ANALYSIS: SINGLE UNIT TRUCKS BY ROADWAY TYPE

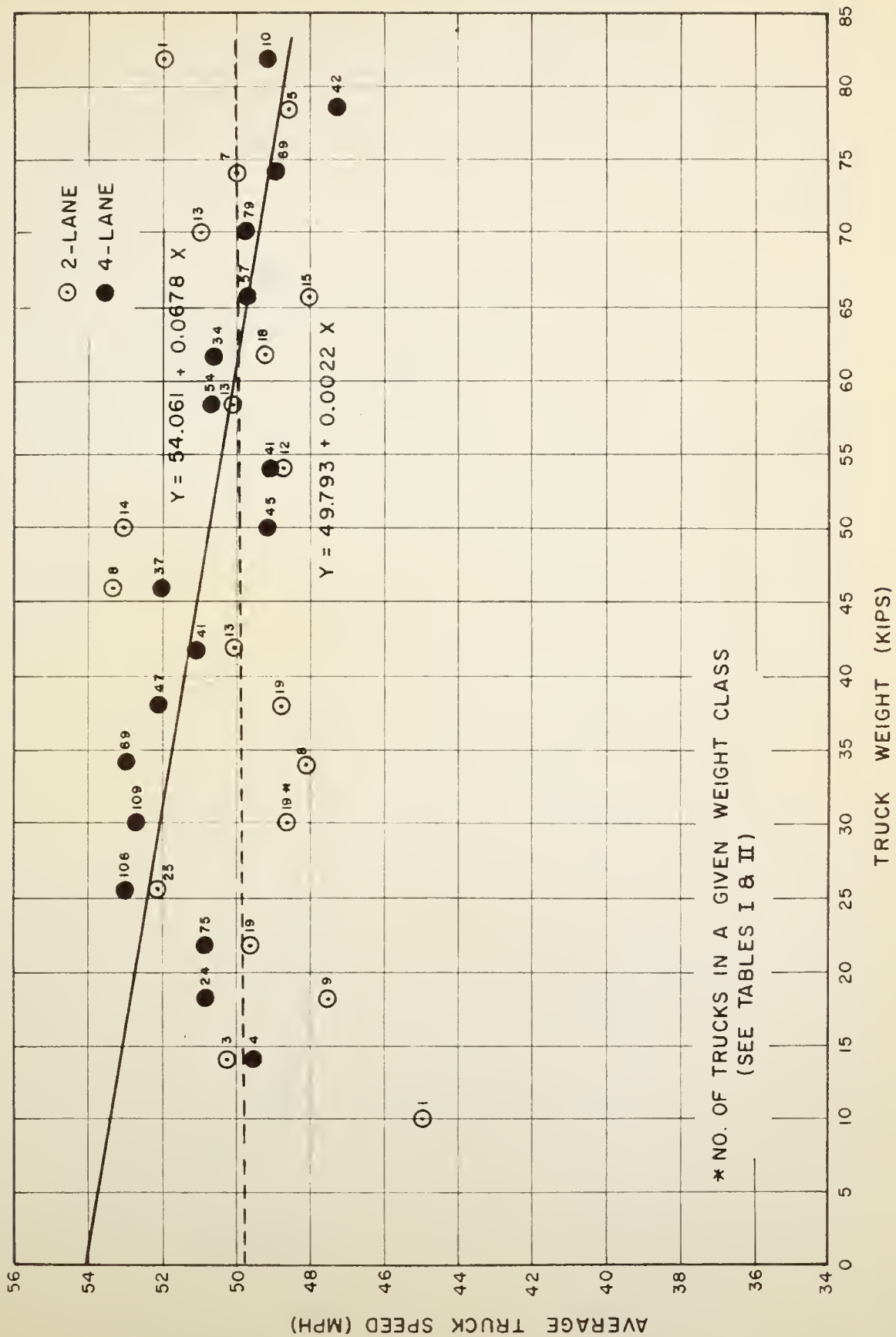


FIG. 8 - REGRESSION ANALYSIS: MULTI-UNIT TRUCKS BY ROADWAY TYPE

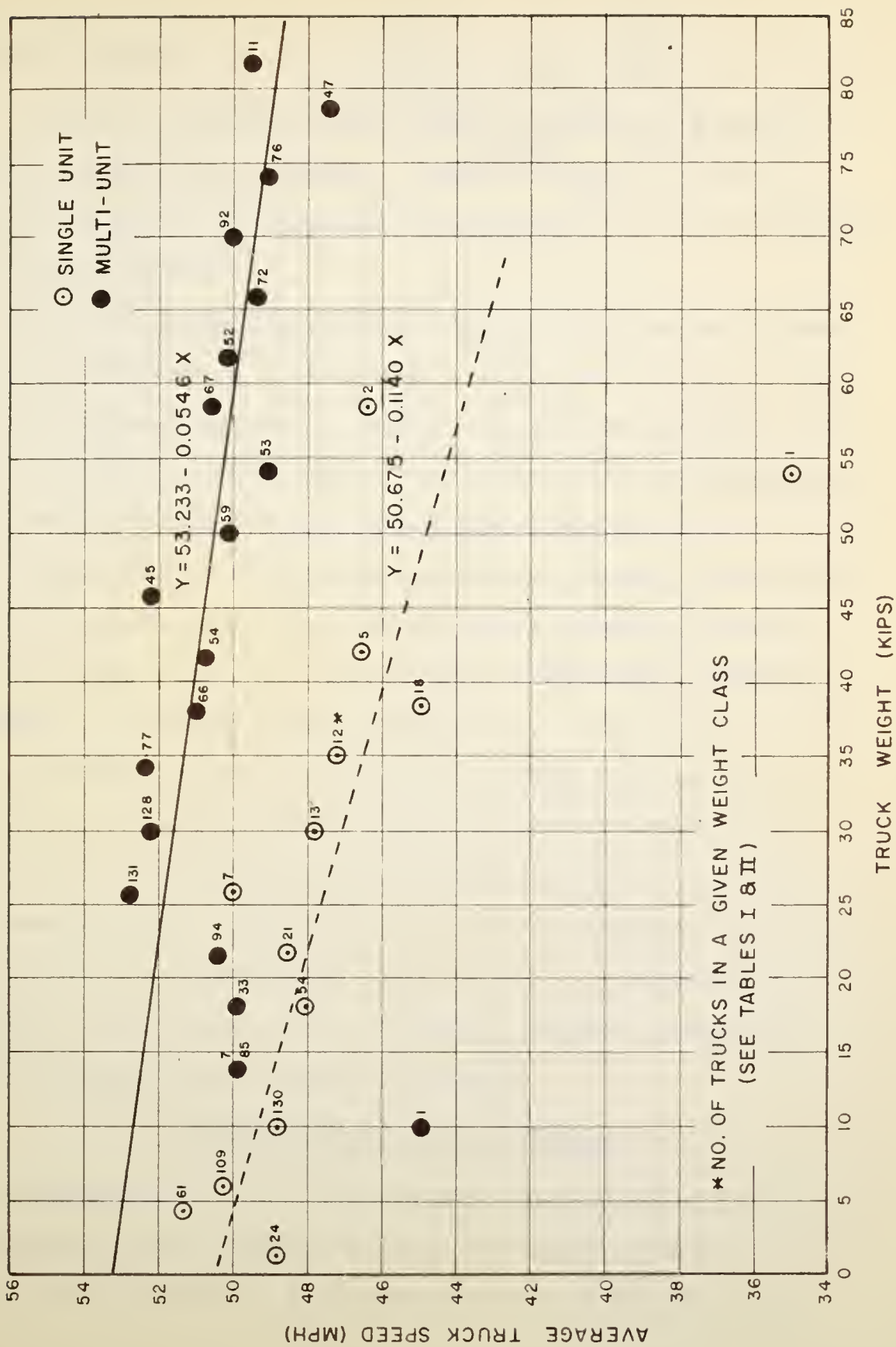


FIG.9-REGRESSION ANALYSIS: ALL TRUCKS BY TRUCK TYPE

single unit (total)	0.1618	0.0271
Multi-unit (total)	0.2027	0.0411

A positive 1.00 for "r" would indicate that there was a positive linear association in the samples. A value of 1.00 for " r^2 " would indicate that all of the variability in a truck's speed could be explained by the truck's weight.

The trends in the 85th percentile truck speeds on two-lane highways, Figure 5, still seem to be increasing. Whereas, the trends on four-lane highways, Figure 6, seem to be leveling just above the speed limit. The results in Table 3 indicate that a large number, 31.1% of the heavy single unit trucks and 48.6% of the multi-unit trucks, were exceeding the 50 mile per hour speed limit on the two lane facilities. But only 6.1% and 9.0% of the trucks exceeded 55 miles per hour. This indicates a tendency for many trucks to travel at the same speed on both types of facilities despite the differences in speed limits.

The overall average speed (Table 4) for single unit and multi-unit trucks decreased approximately one mile per hour from last year. The values for last year increased approximately five miles per hour from the proceeding year. When results of the previous seventeen years are considered, it is doubtful that a downward trend in truck speeds is beginning. Further study will be required to determine a change in the past upward trend in average truck speeds.

Recommendations for Future Studies

1. Weight Station 81 at West Baden should be replaced by another two-lane station for the weight-speed study. The topography in the area makes it very difficult to find a satisfactory level, tangent section

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References

1. J. L. L. (1961) *Journal of the Royal Statistical Society*, **24**, 1-10.

2. J. L. L. (1962) *Journal of the Royal Statistical Society*, **25**, 1-10.

3. J. L. L. (1963) *Journal of the Royal Statistical Society*, **26**, 1-10.

4. J. L. L. (1964) *Journal of the Royal Statistical Society*, **27**, 1-10.

to record the truck speeds.

2. A 50 foot extension cord should be purchased for the radar meter.

This would facilitate concealing the personnel recording the speeds of the passing trucks. Truck drivers seem very proficient at detecting unusual activities, such as, a radar unit.

to receive the same.

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